REQUIRED RANGE OF KNOWLEDGE - Wastewater Treatment Plant Operator, Grade 1

Applicants are not expected to have a complete mastery of all subjects but at least should have heard of them in the context of wastewater treatment. Ability in basic arithmetic and an understanding of basic conversions is requisite. An awareness of different treatment plant types is expected. Introduction to regulatory concepts.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Pollution prevention of potable water sources; Discharge permits – APP, AZPDES; Wastewater Sources – industrial, commercial, domestic, combined, runoff, inflow/infiltration; Define: facility,On-site operator, on-site representative, sewage; direct respsonible charge; operator	Arizona Administrative Code, Title 18, Chapter 4, Articles 1 – 8 and Title 18, Chapter 5, Article 1; R18-5-104.C,E; R18-9-B201.E, D
Water Reclamation and Reuse	Irrigation; Recharge; Natural reclamation – microstaining, polishing ponds; Distribution and storage; Surface disposal; deep well injection, pretreatment; Oxygen starvation (methemoglobinemia) in infants;	Arizona Administrative Code, Title 18, Chapter 9, Articles 1 – 7 Question to be added.
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of sulfur dioxide, chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand and its significance; Free available vs. Combined chlorine; Breakpoint chlorination;Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1, 6th Ed.Ch. 10 Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Chemistry ~ Sampling and Analysis	Elements; Compounds; definition of an organic compound; pH and the significance of changes; chemical name for Cu; molecular structure of elemental chlorine; Suspended Solids Test; Define:MCRT, Facultative, Anaerobic, Aerobic,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1 5th Ed. Ch.9, Vol. 2, 6th Ed. Ch. 16 Any Student Chemistry Handbook
System Operation	Pump Type – centrifugal, propeller, positive displacement, Progressing Cavity, Operation and Maintenance of Trickling Filters,Stabilization Ponds; calculation of pump output; Valve Type – gate, check, plug, ball, globe;Magnetic Flow Meter; Venturi Meter Diagnosis of minor electrical problems Define: Nocardia, Nematodes, Rotifers,Stalked ciliates,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 2, 6th Ed. Ch. 15
Wastewater Treatment Techniques	Primary Treatment – bar screens, grit removal Primary Sedimentation – clarifiers, ponds, sludge removal; Secondary Treatment – lagoons, package plants, oxidation ditch; ponds; Sludge Disposal; operation and maintenance of trickling filter; anaerobic digester compents	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Ch. 9, Vol. 2, 6th Ed.
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies; Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Protection against inhalation of chlorine gas; Chlorine storage, feeding, and measurements; Operation and maintenance gas chlorinator;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Contingency Plan R18-9-A204	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Area and volume; Flow rates and feed rates; Percentage; Fractions; Sludge volume index; Detention time	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.

REQUIRED RANGE OF KNOWLEDGE - Wastewater Treatment Plant Operator, Grade 2

Applicants are expected to have mastered all items listed under Grades 1 and 2, and a familiarity with the subjects listed under Grade 3. Must have the ability to make a wide range of wastewater treatment calculations. Must possess a well-developed knowledge of national and local clean water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Pollution prevention of potable water sources; Discharge permits – APP, NPDES, AZPDES; Wastewater Sources – industrial, commercial, domestic, combined, runoff, inflow/infiltration; Define: facility,On-site operator, on-site representative, sewage; direct respsonible charge; operator	Arizona Administrative Code, Title 18, Chapter 9; Arizona Administrative Code, Title 18, Chapter 4, Articles 1 – 8 and Title 18, Chapter 5, Article 1; 'R18-5-104.E.5;R18-9-B201.E.D;
Water Reclamation and Reuse	Irrigation; Recharge; Natural reclamation – microstaining, polishing ponds; Distribution and storage; Surface disposal – drainfield, mounds, tile drain, deep well injection, pretreatment; Oxygen starvation (methemoglobinemia) in infants;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Arizona Administrative Code, Title 18, Chapter 9, Articles 1 – 7

SECTION	TOPIC	REFERENCE
Disinfection	Purpose of disinfection; Disinfectant types; Sulfur Dioxide, Characteristics(physical and chemical) of Chlorine and Chlorine compounds; Available chlorine in various compounds; Chlorine demand and its significance; Free vs. Combined chlorine; Breakpoint chlorination; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts;General knowledge of Cryptosporidium and Giardia infestation; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide Define:Pathogen Bacteria,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.
Chemistry ~ Sampling and Analysis	Elements; Compounds; Definite Organic Compound, Acidic Solution; Molecular Formula of Chlorine Dioxide,Elemental Chlorine; Sodium Hydroxide, sodium hypochlorite,sulfuric acid,ammonium ion, pH and the significance of changes; chemical name for Cu; BOD, COD, settleable solids, turbidity, volatile solids,Nitrogen Removal,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1 5th Ed. Ch.9, Vol. 2, 6th Ed. Ch. 16 Any Student Chemistry Handbook

SECTION	TOPIC	REFERENCE
Plant Operation and Maintenance	Pump Types: Progressive Cavity, Pneumatic Ejector; Maintenance, Seals, Motor types, Flow meters, Weirs, Flumes;Trickling Filters Types: Gravity Sand; Define: Nocardia, Nematodes, Rotifers,Stalked Ciliates, Nitrification, Bacteria Type – Aerobic, Anaerobic, Facultative; Activated Sludge Process; Sludge Disposal, Sludge Bulking, Primary and Secondary Sludge; Sludge Incineration; Chemical Sludge Conditioning; O&M of Stabilization Ponds, Anaerobic Digesters,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies; Cl_2 gas safety training, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.CSUS Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Contingency Plan R18-9-A204	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Scientific notation; Rounding; Solve for unknown; Velocity; Loading; Concentrations; Area and Volume; Flow rates and feed rates; Percentage and fractions	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.

REQUIRED RANGE OF KNOWLEDGE - Wastewater Treatment Plant Operator, Grade 3

Applicants are expected to have mastered all items listed under Grades 1, 2, and 3 plus a practical familiarity with treatment plant design, water utility management, safety, and public health. Must have the ability to make a wide range of water utility calculations is expected. Extensive knowledge of all drinking water regulations.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Pollution prevention; Discharge permits – APP, NPDES, AZPDES; Wastewater Sources – industrial, commercial, domestic, runoff, inflow/infiltration; Clean Water Act - Water Quality Standards; 503 regulations; ADEQ classes of reuse water; Define: facility,On-site operator, on-site representative, sewage; direct respsonible charge; operator	Arizona Administrative Code, Title 18, Chapter 9; Arizona Administrative Code, Title 18, Chapter 4, Articles 1 – 8 and Title 18, Chapter 5, Article 1; R18-9-B201.D.E,
Water Reclamation and Reuse	Irrigation; Recharge; Natural reclamation – microstaining, polishing ponds; Distribution and storage; Surface disposal – drainfield, mounds, tile drain, deep well injection, pretreatment; Oxygen starvation (methemoglobinemia) in infants;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Arizona Administrative Code, Title 18, Chapter 9, Articles 1 – 7
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Free vs. Combined chlorine; Breakpoint chlorination; Residual measurement; Gas vs. Liquid; application and methods; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5, Molecular Formula of Ozone,Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Chemisrty ~ Sampling and Analysis	Elements; Compounds; definition of an organic compound; pH and the significance of changes; chemical name for Cu; molecular structure of elemental chlorine;Define:Divalent, Normality, Reagent, Chelation,Molecular Formula of: Alum,Ammonia,Nitrate Ion; TKN, COD, TOC, TSS, Volatile Solids; Fecal Coliform Test; Microbiology: Types of Filaments, Protozoans, Metazoans; Nutrients – oxygen, temperature, pH, toxin	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1 5th Ed. Ch.9, Vol. 2, 6th Ed. Ch. 16 Any Student Chemistry Handbook
Plant Operation and Maintenance	Activated sludge; Phosphorus and Nitrogen Removal:Nitrification and Denitrification SBRs: WAS and RAS rate, MCRT, F/M; Settleability Trouble Shooting; Sludge Disposal, Sludge Bulking, Primary and Secondary Sludge; Sludge Incineration; Chemical Sludge Conditioning; Agricultural Application; O&M of: Trickling Filters, Anaerobic Digesters;Hydrogen Peroxide for Odor Control ; Define: Filamentous Growth, Elutriation, Surface Straining, Depth Filtration, Endogenous Respiration, Bacteria Type – Aerobic, Anaerobic, Facultative, Nocardia, Nematodes, Rotifers,Stalked ciliates	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Pretreatment and Industrial Waste	Monitoring and reporting requirements – federal and local; Point source and non-point source contamination; Conventional and priority pollutants; Baseline monitoring; Pollution prevention	Question To Be Added

SECTION	TOPIC	REFERENCE
Safety	Common hazards; Sanitary hazards; Equipment; Emergencies, Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures; Hazard recognition in Trenching and shoring, ladder and climbing devices, soil types and spoil placement; utility location	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas; IDLH for Chlorine Gas.	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Contingency Plan R18-9-A204	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units; Conversion; Concentration; Area; Volume; Flow/Feed rate; Percentage: Fractions	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.

REQUIRED RANGE OF KNOWLEDGE - Wastewater Treatment Plant Operator, Grade 4

Applicants are expected to have mastered all items listed under Grades 1, 2, and 3 plus a practical familiarity with treatment plant design, water utility management, safety, and public health. Must have the ability to make a wide range of water utility calculations. Extensive regulatory knowledge.

SECTION	TOPIC	REFERENCE
Regulatory Knowledge	Pollution prevention; Discharge permits – APP, NPDES, AZPDES; Wastewater Sources – industrial, commercial, domestic, runoff, inflow/infiltration; Clean Water Act - Water Quality Standards; 503 regulations; ADEQ classes of reuse water; Define: facility,On-site operator, on-site representative, sewage; direct respsonible charge; operator	Arizona Administrative Code, Title 18, Chapter 9; Arizona Administrative Code, Title 18, Chapter 4, Articles 1 – 8 and Title 18, Chapter 5, Article 1; 'R18-5-104.E.5; 'R18-5-116.C; R18-9-B201.D
Water Reclamation and Reuse	Irrigation; Recharge; Natural reclamation – microstaining, polishing ponds; Distribution and storage; Surface disposal – drainfield, mounds, tile drain, deep well injection, pretreatment; Oxygen starvation (methemoglobinemia) in infants;	Arizona Administrative Code, Title 18, Chapter 9, Articles 1 – 7
Disinfection	Purpose of disinfection; Disinfectant types; Characteristics of chlorine and chlorine compounds; Available chlorine in various compounds; Chlorine demand; Free vs. Combined chlorine;monochloramine, dichloramine, and trichloramine; Breakpoint chlorination; Residual; Gas vs. Liquid; Effects of pH and temperature; chloramines; Relative effects on bacteria, viruses, cysts; Disinfection Byproducts Precursors, TTHM formation and HAA5 Define: Hypochlorous acid, Hydrochloric acid, Hypochlorite ion, Elmental chlorine, chlorine dioxide	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Chemistry	Elements; Compounds; definition of an organic compound; pH and the significance of changes; Molecular Structure of elemental Chlorine; Molecular Formula of: Calcium hypochlorite, Chlorine dioxide, Sodium hydroxide, Sodium hypochlorite, Sulfuric acid, Ammonium ion; Chemical symbol for chlorine; Chemical name for Cu;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1 5th Ed. Ch.9, Vol. 2, 6th Ed. Ch. 16 Any Student Chemistry Handbook
Plant Operation and Maintenance	Activated sludge; Phosphorus and Nitrogen Removal:Nitrification and Denitrification SBRs: WAS and RAS rate, MCRT, F/M; Settleability Trouble Shooting; Sludge Disposal,sludge Bulking, Primary and Secondary Sludge; Sludge Incineration; Chemical Sludge Conditioning; Agricultural Application; O&M of:Dissolved Air Flotation Units, Trickling Filters, Anaerobic Digesters; Hydrogen Peroxide for Odor Control; Define: Filamentous Growth, Nocardia, Nematodes, Rotifers,Stalked ciliates, Surface Straining, Depth Filtration, Endogenous Respiration, Bacteria Type – Aerobic, Anaerobic, Facultative, Thiothrix, Bacteria Type – Aerobic, Anaerobic, Facultative, Elutriation, Volatile Acid/Alkalinity Ratio,	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed
Pretreatment and Industrial Waste	Monitoring and reporting requirements – federal and local; Point source and non-point source contamination; Conventional and priority pollutants; Baseline monitoring; Pollution prevention	Questions to be Added

SECTION	TOPIC	REFERENCE
Safety	MSDS, Sanitary hazards; Biohazards; Equipment – SCBA, Emergencies; Personal hygiene; Blood-borne pathogens; Lock out/Tag out; Confined space entry; Backflow and cross connection control; Confine space procedures;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.
Chlorine gas safety	Detection of leaks; Hazards and safety requirements for all types of disinfectants; Characteristics of fusible plugs in chlorine containers; Effects of heat applied to chlorine cylinder; Protection against inhalation of chlorine gas; Feed rate as effected by temperature, cylinder volume, and cylinder position; Chlorine storage, feeding, and measurements; Operation and maintenance of an auto analyzer, hypochlorinator and gas chlorinator; Effects of moisture on chlorine gas; IDLH for chlorine gas;	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed. Handbook of Chlorination and Alternative Disinfectants, 4th Ed. Or other Chlorination and Disinfection reference material.

SECTION	TOPIC	REFERENCE
Introduction to Security concerns	Define: Vulnerability Assessment, Preparedness, Recovery, Mitigation, Detection, Delay and Response, Emergency Response Plan ~ Contingency Plan R18-9-A204	Reference: Water and Wastewater Security Product Guide, "Visual Surveillance Monitoring," USEPA, April 20, 2004 ~ Protecting Your Community's Assets: A Guide for Small Wastewater Systems, NETCSC, Nov. 2002, page 38 ~ Emergency Planning Interactive Guide, Illinois Section American Water Works Association and Midwest Technology Assistance Center, www.isawwa.org (click on "Emergency Planning CD"), Mutual Aid Overview page. ~ Emergency Preparedness U.S.A., FEMA, Unit 1, pages 1-2 ~ Guarding Against Terrorist and Security Threats: Suggested Measures for Drinking Water and Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002, USEPA, April 7, 2004
Math Concepts	Formulas; Units and conversion factors; Water measurements; Concentrations; Volume; Area; Flow rates and feed rates; Percentage; Fractions	CSUS ~Operation of Wastewater Treatment Plants. Vol. 1,5th Ed. Vol. 2, 6th Ed.